

# THE LANCET

## **Supplementary appendix**

This appendix formed part of the original submission and has been peer reviewed.  
We post it as supplied by the authors.

Supplement to: Hall VJ, Foulkes S, Charlett A, et al. SARS-CoV-2 infection rates of antibody-positive compared with antibody-negative health-care workers in England: a large, multicentre, prospective cohort study (SIREN). *Lancet* 2021; published online April 9. [http://dx.doi.org/10.1016/S0140-6736\(21\)00675-9](http://dx.doi.org/10.1016/S0140-6736(21)00675-9).

## APPENDIX 1

### Appendix A

Box 1.

#### **Embase and MEDLINE search strategy:**

1 (coronavirus\* or coronovirus\* or coronavirinae\* or Coronavirus\* or Coronovirus\* or Wuhan\* or Hubei\* or Huanan or "2019-nCoV" or 2019nCoV or nCoV2019 or "nCoV-2019" or "COVID-19" or COVID19 or "CORVID-19" or CORVID19 or "WN-CoV" or WNCov or "HCoV-19" or HCoV19 or CoV or "2019 novel\*" or Ncov or "n-cov" or "SARS-CoV-2" or "SARSCoV-2" or "SARSCoV2" or "SARS-CoV2" or SARSCov19 or "SARS-Cov19" or "SARSCov-19" or "SARS-Cov-19" or Ncovor or Ncorona\* or Ncorono\* or NcovWuhan\* or NcovHubei\* or NcovChina\* or NcovChinese\*).ti,ab,kw.

2 (reinfection\* or re-infection\* or "second episode" or recurrence\* or recrudescence\* or relapse\* or RCOVID19).m\_titl.

3 exp Recurrence/

4 2 or 3

5 1 and 4

6 limit 5 to English language

#### **Preprint and the WHO COVID-19 Literature Database search strategy:**

reinfection or reinfections or re-infection or re-infections or "second episode" or recurrence or recurrences or recrudescence or recrudescences or relapse or relapses or RCOVID19

## Appendix B: Case definitions

Status	Definition
Confirmed reinfection	<p>Two PCR positive episodes, which are at least 90 days apart, supported by:</p> <p>Viral genomic data from both episodes of infection*</p> <p><b>AND</b></p> <p>Quantitative serological investigation.</p>
Probable reinfection	<ul style="list-style-type: none"> <li>SARS-CoV-2 seropositive person with a new PCR-positive infection episode, with at least four weeks between the positive antibody result and the onset of new infection, supported by quantitative serological data.</li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>Two PCR positive episodes which are at least 90 days apart, supported by supported by viral genomic data, such as the second episode showing phylogeny congruent with contemporaneous infections.</li> </ul>
Possible reinfection	<ul style="list-style-type: none"> <li>SARS-CoV-2 seropositive person with a new PCR-positive infection episode, with at least four weeks between the positive antibody result and the onset of new infection.</li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>Two PCR positive episodes which are at least 90 days apart</li> </ul>
Reinfection excluded	<ul style="list-style-type: none"> <li>Intermittent PCR positivity: two PCR positive results less than 90 days apart and no viral genomics available.</li> <li>Persistent PCR positivity: <ul style="list-style-type: none"> <li>Two PCR positive episodes at least 90 days apart where sequencing is available for both episodes and indicates persistence</li> <li>Two PCR positive episodes at least 90 days apart where sequencing is available for the second episode only and sequence not congruent with contemporaneous infections and indicates persistence</li> </ul> </li> </ul>

\*Additional testing with patient consent can be performed, such as human genotyping (confirming samples from same patient) **OR** a second sample taken directly from the patient for sequencing (reduced likelihood of laboratory error).

## Appendix C

**Table C: Demographics of SIREN participants by baseline cohort allocation, presenting positive cohort sub-groups, participants enrolled 18 June to 31 December 2020 (n=25,661)**

Characteristics		Antibody positive	PCR positive and no antibody data	Antibody negative prior antibody positive and PCR positive	Antibody negative prior antibody positive	Antibody negative prior PCR positive	Antibody negative no prior antibody positive or PCR positive
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Gender							
	Female	6218 (82.3)	129 (89.0)	92 (85.2)	282 (85.5)	119 (82.6)	14777 (85.0)
	Male	1321 (17.5)	16 (11)	16 (14.8)	47 (14.2)	25 (17.4)	2585 (14.9)
	Other	12 (0.2)	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	21 (0.1)
Age							
	Median [IQR]	45.8 [34.6-54]	46.5 [34.2-54]	44.7 [31.3-50.9]	44 [35.6-53.6]	45.7 [35.8-53.9]	45.7 [35.4-53.5]
	Range	18.6-78.1	21.3-65.5	22.6-60.8	18.7-64.2	18.6-84.3	18.6-84.3
Ethnicity							
	White	6339 (83.9)	116 (80)	94 (87)	287 (87)	133 (92.4)	15435 (88.8)
	Mixed Race	661 (8.8)	19 (13.1)	7 (6.5)	28 (8.5)	9 (6.3)	1049 (6.0)
	Asian	222 (2.9)	5 (3.4)	1 (0.9)	6 (1.8)	2 (1.4)	289 (1.7)
	Black	128 (1.7)	2 (1.4)	3 (2.8)	1 (0.3)	0 (0.0)	278 (1.6)
	Chinese	137 (1.8)	2 (1.4)	3 (2.8)	5 (1.5)	0 (0.0)	199 (1.1)
	Other Ethnic Group	48 (0.6)	1 (0.7)	0 (0.0)	2 (0.6)	0 (0.0)	100 (0.6)
	Prefer not to say	16 (0.2)	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	33 (0.2)
Medical conditions							
	No medical condition	5615 (74.4)	110 (75.9)	86 (79.6)	272 (82.4)	112 (77.8)	12930 (74.4)
	Chronic respiratory condition	952 (12.6)	12 (8.3)	13 (12.0)	28 (8.5)	14 (9.7)	2229 (12.8)
	Chronic non-respiratory condition	847 (11.2)	20 (13.8)	8 (7.4)	25 (7.6)	9 (6.3)	1837 (10.6)
	Immunosuppression	137 (1.8)	3 (2.1)	1 (0.9)	5 (1.5)	9 (6.3)	387 (2.2)
Staff group							
	Nursing/Healthcare assistant	3406 (45.1)	85 (58.6)	47 (43.5)	144 (43.6)	69 (47.9)	7140 (41.1)
	Administrative/Executive	998 (13.2)	13 (9.0)	8 (7.4)	54 (16.4)	17 (11.8)	2813 (16.2)
	Doctor	907 (12.0)	24 (16.6)	16 (14.8)	34 (10.3)	18 (12.5)	1784 (10.3)
	Specialist staff	441 (5.8)	5 (3.4)	9 (8.3)	26 (7.9)	8 (5.6)	1059 (6.1)
	Healthcare scientist	198 (2.6)	1 (0.7)	4 (3.7)	15 (4.5)	7 (4.9)	669 (3.8)
	Midwife	173 (2.3)	1 (0.7)	3 (2.8)	10 (3.0)	2 (1.4)	460 (2.6)
	Pharmacist	99 (1.3)	2 (1.4)	5 (4.6)	5 (1.5)	1 (0.7)	278 (1.6)
	Estates/Porters/Security	87 (1.2)	1 (0.7)	2 (1.9)	1 (0.3)	4 (2.8)	161 (0.9)
	Other	1242 (16.4)	13 (9.0)	14 (13.0)	41 (12.4)	18 (12.5)	3019 (17.4)
Patient facing role							
	Yes	6631 (87.8)	138 (95.2)	99 (91.7)	284 (86.1)	128 (88.9)	14832 (85.3)

	No	920 (12.2)	7 (4.8)	9 (8.3)	46 (13.9)	16 (11.1)	2551 (14.7)
<b>Index of Multiple Deprivation</b>							
(most deprived) 1		992 (13.1)	12 (8.3)	12 (11.1)	23 (7.0)	15 (10.4)	1862 (10.7)
2		1345 (17.8)	27 (18.6)	15 (13.9)	64 (19.4)	18 (12.5)	3094 (17.8)
3		1654 (21.9)	34 (23.4)	29 (26.9)	71 (21.5)	35 (24.3)	4019 (23.1)
4		1725 (22.8)	26 (17.9)	22 (20.4)	75 (22.7)	32 (22.2)	4125 (23.7)
(least deprived) 5		1758 (23.3)	43 (29.7)	28 (25.9)	95 (28.8)	44 (30.6)	4127 (23.7)
Not known		77 (1.0)	3 (2.1)	2 (1.9)	2 (0.6)	0 (0.0)	156 (0.9)
<b>Region</b>							
South West		1056 (14.0)	4 (2.8)	15 (13.9)	59 (17.9)	21 (14.6)	4155 (23.9)
London		1176 (15.6)	45 (31)	11 (10.2)	35 (10.6)	6 (4.2)	1918 (11.0)
North West		1150 (15.2)	14 (9.7)	16 (14.8)	31 (9.4)	18 (12.5)	1888 (10.9)
East of England		792 (10.5)	33 (22.8)	7 (6.5)	9 (2.7)	22 (15.3)	2086 (12.0)
South East		697 (9.2)	31 (21.4)	33 (30.6)	110 (33.3)	43 (29.9)	1996 (11.5)
East Midlands		807 (10.7)	4 (2.8)	9 (8.3)	49 (14.8)	9 (6.3)	1800 (10.4)
West Midlands		782 (10.4)	2 (1.4)	12 (11.1)	21 (6.4)	16 (11.1)	1779 (10.2)
Yorkshire and the Humber		892 (11.8)	11 (7.6)	4 (3.7)	13 (3.9)	6 (4.2)	1394 (8.0)
North East		199 (2.6)	1 (0.7)	1 (0.9)	3 (0.9)	3 (2.1)	367 (2.1)
<b>All Participants</b>		<b>7551 (29.4)</b>	<b>145 (0.6)</b>	<b>108 (0.4)</b>	<b>330 (1.3)</b>	<b>144 (0.6)</b>	<b>17383 (67.7)</b>

## Appendix D:

**Table Di: Multivariable analysis of risk of infection by cohort during SIREN follow-up, probable reinfections, between 18 June 2020 and 11 January 2021 (n=2)**

Characteristics	IRR (95% CI)	p-value
Positive	0.00 (0.00-0.01)	<0.0001
SGTF	2.82 (2.37-3.35)	<0.0001
Vaccine	0.39 (0.20-0.75)	0.005
<b>Week group</b>		
<25/08/2020	Reference	
25/08/2020 to 07/09/2020	6.55 (1.85-23.22)	0.004
08/09/2020 to 21/09/2020	21.83 (7.49-63.59)	<0.0001
22/09/2020 to 05/10/2020	22.62 (7.82-65.43)	<0.0001
06/10/2020 to 19/10/2020	99.92 (36.81-271.23)	<0.0001
20/10/2020 to 02/11/2020	140.93 (52.20-380.5)	<0.0001
03/11/2020 to 16/11/2020	156.01 (57.86-420.71)	<0.0001
17/11/2020 to 30/11/2020	145.49 (53.90-392.75)	<0.0001
01/12/2020 to 14/12/2020	163.40 (60.66-440.11)	<0.0001
15/12/2020 to 28/12/2020	268.82 (99.93-723.11)	<0.0001
>28/12/2020	480.39 (177.59-1299.47)	<0.0001
<b>Age group</b>		
18 to 24	Reference	
25 to 34	0.61 (0.50-0.76)	<0.0001
35 to 44	0.46 (0.37-0.57)	<0.0001
45 to 54	0.44 (0.35-0.54)	<0.0001
55 to 64	0.39 (0.31-0.48)	<0.0001
Over 65	0.24 (0.14-0.42)	<0.0001
<b>Gender</b>		
Male	Reference	
Female	0.98 (0.85-1.13)	0.751
Other	1.41 (0.44-4.48)	0.565
<b>Ethnicity</b>		
White	Reference	
BAME	1.24 (1.07-1.44)	0.004
<b>Staff group</b>		
Nursing/Healthcare Assistant	Reference	
Doctor	0.82 (0.69-0.98)	0.027
Midwife	0.64 (0.46-0.90)	0.011
Administrative/Executive	0.63 (0.54-0.74)	<0.0001
Specialist staff	0.78 (0.63-0.96)	0.020
Estates/Porters/Security	1.32 (0.88-1.98)	0.187
Pharmacist	0.69 (0.47-1.01)	0.054
Healthcare Scientist	0.45 (0.33-0.63)	<0.0001
Other	0.80 (0.69-0.91)	0.001
<b>Index of Multiple Deprivation</b>		
1 (most deprived)	Reference	
2	0.88 (0.74-1.05)	0.151
3	0.82 (0.69-0.98)	0.026
4	0.87 (0.74-1.04)	0.118
5 (least deprived)	0.84 (0.70-1.00)	0.046
<b>Region</b>		
East Midlands	Reference	
East of England	0.82 (0.53-1.26)	0.369
London	0.75 (0.49-1.14)	0.177
North East	0.78 (0.38-1.60)	0.504
North West	1.23 (0.81-1.85)	0.330
South East	0.64 (0.42-0.96)	0.033
South West	0.52 (0.35-0.78)	0.001
West Midlands	0.76 (0.50-1.16)	0.201
Yorkshire and the Humber	0.89 (0.57-1.41)	0.630

SGTF: single gene target failure; Vaccine: received COVID-19 vaccine at least 21 days previously; BAME: Black, Asian or minority ethnic group

**Table Dii: Multivariable analysis of risk of infection by cohort during SIREN follow-up, COVID-19 symptomatic infections, between 18 June 2020 and 11 January 2021 (n=50)**

Characteristics	IRR (95% CI)	p-value
Positive	0.07 (0.06-0.10)	<0.0001
SGTF	2.56 (2.08-3.15)	<0.0001
Vaccine	0.18 (0.06-0.57)	0.004
<b>Week group</b>		
<25/08/2020	Reference	
25/08/2020 to 07/09/2020	8.76 (2.19-35.03)	0.002
08/09/2020 to 21/09/2020	9.73 (2.52-37.63)	0.001
22/09/2020 to 05/10/2020	22.39 (6.56-76.42)	<0.0001
06/10/2020 to 19/10/2020	98.17 (30.97-311.17)	<0.0001
20/10/2020 to 02/11/2020	124.69 (39.53-393.34)	<0.0001
03/11/2020 to 16/11/2020	141.06 (44.80-444.13)	<0.0001
17/11/2020 to 30/11/2020	128.79 (40.84-406.18)	<0.0001
01/12/2020 to 14/12/2020	146.90 (46.72-461.92)	<0.0001
15/12/2020 to 28/12/2020	273.01 (87.06-856.13)	<0.0001
>28/12/2020	499.29 (158.12-1576.52)	<0.0001
<b>Age group</b>		
18 to 24	Reference	
25 to 34	0.69 (0.53-0.90)	0.006
35 to 44	0.48 (0.37-0.62)	<0.0001
45 to 54	0.47 (0.36-0.61)	<0.0001
55 to 64	0.42 (0.32-0.55)	<0.0001
Over 65	0.26 (0.13-0.50)	<0.0001
<b>Gender</b>		
Male	Reference	
Female	1.07 (0.89-1.27)	0.478
Other	2.09 (0.64-6.75)	0.220
<b>Ethnicity</b>		
White	Reference	
BAME	1.08 (0.91-1.30)	0.379
<b>Staff group</b>		
Nursing/Healthcare Assistant	Reference	
Doctor	0.92 (0.75-1.13)	0.422
Midwife	0.50 (0.31-0.79)	0.003
Administrative/Executive	0.61 (0.50-0.74)	<0.0001
Specialist staff	0.81 (0.63-1.03)	0.086
Estates/Porters/Security	1.04 (0.59-1.82)	0.898
Pharmacist	0.72 (0.46-1.13)	0.153
Healthcare Scientist	0.36 (0.23-0.56)	<0.0001
Other	0.84 (0.71-0.99)	0.035
<b>Index of Multiple Deprivation</b>		
1 (most deprived)	Reference	
2	0.91 (0.73-1.12)	0.362
3	0.89 (0.72-1.10)	0.275
4	0.88 (0.72-1.09)	0.240
5 (least deprived)	0.90 (0.73-1.11)	0.324
<b>Region</b>		
East Midlands	Reference	
East of England	0.84 (0.55-1.28)	0.412
London	0.81 (0.54-1.22)	0.315
North East	0.70 (0.34-1.43)	0.321
North West	1.22 (0.82-1.81)	0.331
South East	0.70 (0.47-1.05)	0.084
South West	0.48 (0.33-0.71)	<0.0001
West Midlands	0.80 (0.53-1.21)	0.293
Yorkshire and the Humber	0.92 (0.59-1.43)	0.709

SGTF: single gene target failure; Vaccine: received COVID-19 vaccine at least 21 days previously; BAME: Black, Asian or minority ethnic group

**Table Diii: Multivariable analysis of risk of infection by cohort during SIREN follow-up, other symptomatic infections, between 18 June 2020 and 11 January 2021 (n=28)**

Characteristics	IRR (95% CI)	p-value
Positive	0.21 (0.14-0.32)	<0.0001
SGTF	3.54 (2.25-5.57)	<0.0001
Vaccine	0.61 (0.15-2.50)	0.489
<b>Week group</b>		
<25/08/2020	Reference	-
25/08/2020 to 07/09/2020	-	-
08/09/2020 to 21/09/2020	16.61 (3.53-78.25)	<0.0001
22/09/2020 to 05/10/2020	5.89 (0.98-35.25)	0.052
06/10/2020 to 19/10/2020	22.72 (5.08-101.59)	<0.0001
20/10/2020 to 02/11/2020	46.53 (11.01-196.60)	<0.0001
03/11/2020 to 16/11/2020	46.33 (10.96-195.77)	<0.0001
17/11/2020 to 30/11/2020	50.41 (11.98-212.24)	<0.0001
01/12/2020 to 14/12/2020	50.48 (12.03-211.76)	<0.0001
15/12/2020 to 28/12/2020	60.63 (14.40-255.24)	<0.0001
>28/12/2020	117.1 (27.23-503.64)	<0.0001
<b>Age group</b>		
18 to 24	Reference	-
25 to 34	0.79 (0.41-1.52)	0.475
35 to 44	0.76 (0.40-1.45)	0.405
45 to 54	0.98 (0.52-1.84)	0.951
55 to 64	0.65 (0.33-1.27)	0.205
Over 65	0.37 (0.08-1.66)	0.192
<b>Gender</b>		
Male	Reference	-
Female	0.84 (0.59-1.20)	0.333
Other	-	-
<b>Ethnicity</b>		
White	Reference	-
BAME	1.33 (0.92-1.91)	0.126
<b>Staff group</b>		
Nursing/Healthcare Assistant	Reference	-
Doctor	0.49 (0.29-0.82)	0.007
Midwife	1.04 (0.50-2.13)	0.921
Administrative/Executive	0.55 (0.37-0.83)	0.004
Specialist staff	0.89 (0.54-1.47)	0.652
Estates/Porters/Security	1.12 (0.41-3.10)	0.822
Pharmacist	0.69 (0.25-1.89)	0.471
Healthcare Scientist	0.64 (0.31-1.31)	0.218
Other	0.72 (0.51-1.03)	0.072
<b>Index of Multiple Deprivation</b>		
1 (most deprived)	Reference	-
2	0.90 (0.59-1.38)	0.625
3	0.73 (0.48-1.13)	0.156
4	0.87 (0.57-1.32)	0.510
5 (least deprived)	0.67 (0.43-1.04)	0.073
<b>Region</b>		
East Midlands	Reference	-
East of England	1.02 (0.56-1.87)	0.954
London	0.63 (0.33-1.21)	0.167
North East	0.89 (0.31-2.55)	0.828
North West	0.78 (0.41-1.47)	0.444
South East	0.55 (0.28-1.06)	0.073
South West	0.56 (0.31-1.00)	0.051
West Midlands	0.70 (0.37-1.32)	0.264
Yorkshire and the Humber	0.67 (0.32-1.40)	0.286

SGTF: single gene target failure; Vaccine: received COVID-19 vaccine at least 21 days previously; BAME: Black, Asian or minority ethnic group



**Table Div: Multivariable analysis of risk of infection by cohort during SIREN follow-up, asymptomatic reinfections, between 18 June 2020 and 11 January 2021 (n=76)**

Characteristics	IRR (95% CI)	p-value
Positive	0.48 (0.37-0.63)	<0.0001
SGTF	2.34 (1.6-3.41)	<0.0001
Vaccine	1.34 (0.54-3.35)	0.526
<b>Week group</b>		
<25/08/2020	Reference	
25/08/2020 to 07/09/2020	2.21 (0.76-6.47)	0.148
08/09/2020 to 21/09/2020	3.38 (1.33-8.57)	0.010
22/09/2020 to 05/10/2020	3.22 (1.27-8.16)	0.014
06/10/2020 to 19/10/2020	9.73 (4.67-20.27)	<0.0001
20/10/2020 to 02/11/2020	13.07 (6.45-26.47)	<0.0001
03/11/2020 to 16/11/2020	12.68 (6.25-25.76)	<0.0001
17/11/2020 to 30/11/2020	10.90 (5.29-22.47)	<0.0001
01/12/2020 to 14/12/2020	17.54 (8.83-34.84)	<0.0001
15/12/2020 to 28/12/2020	22.35 (11.22-44.51)	<0.0001
>28/12/2020	41.40 (20.01-85.65)	<0.0001
<b>Age group</b>		
18 to 24	Reference	
25 to 34	0.44 (0.29-0.67)	<0.0001
35 to 44	0.38 (0.25-0.58)	<0.0001
45 to 54	0.31 (0.21-0.47)	<0.0001
55 to 64	0.36 (0.24-0.55)	<0.0001
Over 65	0.24 (0.08-0.68)	0.007
<b>Gender</b>		
Male	Reference	
Female	0.86 (0.65-1.14)	0.284
Other	2.11 (0.29-15.29)	0.460
<b>Ethnicity</b>		
White	Reference	
BAME	1.66 (1.25-2.22)	0.001
<b>Staff group</b>		
Nursing/Healthcare Assistant	Reference	
Doctor	1.12 (0.78-1.60)	0.528
Midwife	1.06 (0.54-2.09)	0.861
Administrative/Executive	0.85 (0.62-1.18)	0.344
Specialist staff	0.87 (0.54-1.40)	0.571
Estates/Porters/Security	2.85 (1.52-5.37)	0.001
Pharmacist	0.72 (0.29-1.78)	0.483
Healthcare Scientist	0.82 (0.46-1.46)	0.510
Other	0.86 (0.63-1.16)	0.322
<b>Index of Multiple Deprivation</b>		
1 (most deprived)	Reference	
2	0.86 (0.60-1.22)	0.401
3	0.72 (0.50-1.03)	0.069
4	0.75 (0.53-1.07)	0.112
5 (least deprived)	0.71 (0.49-1.02)	0.062
<b>Region</b>		
East Midlands	Reference	
East of England	1.03 (0.63-1.68)	0.906
London	0.58 (0.35-0.98)	0.040
North East	0.33 (0.10-1.14)	0.080
North West	1.31 (0.83-2.07)	0.251
South East	0.52 (0.30-0.89)	0.017
South West	0.63 (0.40-1.00)	0.048
West Midlands	0.62 (0.36-1.05)	0.077
Yorkshire and the Humber	0.58 (0.32-1.07)	0.084

SGTF: single gene target failure; Vaccine: received COVID-19 vaccine at least 21 days previously;  
BAME: Black, Asian or minority ethnic group

**Table Dv: Multivariable analysis of risk of infection by cohort during SIREN follow-up, all infections, between 18 June 2020 and 11 January 2021 (n=155)**

Characteristics	IRR (95% CI)	p-value
Positive	0.16 (0.13-0.19)	<0.0001
SGTF	2.65 (2.25-3.14)	<0.0001
Vaccine	0.41 (0.22-0.77)	0.005
<b>Week group</b>		
<25/08/2020	Reference	
25/08/2020 to 07/09/2020	3.01 (1.39-6.48)	0.005
08/09/2020 to 21/09/2020	5.98 (3.16-11.32)	<0.0001
22/09/2020 to 05/10/2020	6.90 (3.73-12.75)	<0.0001
06/10/2020 to 19/10/2020	27.63 (16.38-46.62)	<0.0001
20/10/2020 to 02/11/2020	37.37 (22.34-62.51)	<0.0001
03/11/2020 to 16/11/2020	41.36 (24.78-69.03)	<0.0001
17/11/2020 to 30/11/2020	38.27 (22.88-64.01)	<0.0001
01/12/2020 to 14/12/2020	45.61 (27.40-75.91)	<0.0001
15/12/2020 to 28/12/2020	73.71 (44.38-122.42)	<0.0001
>28/12/2020	136.43 (81.35-228.79)	<0.0001
<b>Age group</b>		
18 to 24	Reference	
25 to 34	0.60 (0.49-0.74)	<0.0001
35 to 44	0.46 (0.37-0.56)	<0.0001
45 to 54	0.45 (0.37-0.55)	<0.0001
55 to 64	0.39 (0.32-0.49)	<0.0001
Over 65	0.24 (0.14-0.41)	<0.0001
<b>Gender</b>		
Male	Reference	
Female	0.96 (0.84-1.10)	0.578
Other	1.60 (0.58-4.38)	0.360
<b>Ethnicity</b>		
White	Reference	
BAME	1.23 (1.07-1.41)	0.004
<b>Staff group</b>		
Nursing/Healthcare Assistant	Reference	
Doctor	0.86 (0.72-1.01)	0.068
Midwife	0.70 (0.51-0.97)	0.031
Administrative/Executive	0.64 (0.55-0.75)	<0.0001
Specialist staff	0.83 (0.68-1.01)	0.060
Estates/Porters/Security	1.34 (0.91-1.97)	0.137
Pharmacist	0.74 (0.51-1.06)	0.100
Healthcare Scientist	0.48 (0.35-0.65)	<0.0001
Other	0.81 (0.71-0.92)	0.002
<b>Index of Multiple Deprivation</b>		
1 (most deprived)	Reference	
2	0.91 (0.77-1.07)	0.262
3	0.85 (0.72-1.00)	0.047
4	0.88 (0.75-1.03)	0.118
5 (least deprived)	0.83 (0.71-0.99)	0.035
<b>Region</b>		
East Midlands	Reference	
East of England	0.86 (0.56-1.33)	0.510
London	0.72 (0.47-1.10)	0.131
North East	0.74 (0.36-1.52)	0.407
North West	1.21 (0.80-1.82)	0.372
South East	0.69 (0.46-1.05)	0.080
South West	0.55 (0.37-0.82)	0.003
West Midlands	0.74 (0.48-1.13)	0.167
Yorkshire and the Humber	0.87 (0.55-1.37)	0.544

SGTF: single gene target failure; Vaccine: received COVID-19 vaccine at least 21 days previously; BAME: Black, Asian or minority ethnic group

## Appendix E:

### ∞The SIREN study group:

No.	Institution	Name	
1.	Public Health England	N	Andrews
2.	Public Health England	A	Atti
3.	Public Health England	H	Aziz
4.	Public Health England	T	Brooks
5.	Public Health England	CS	Brown
6.	Public Health England	D	Camero
7.	Public Health England	C	Carr
8.	Public Health England	MA	Chand
9.	Public Health England	A	Charlett
10.	Public Health England	H	Crawford
11.	Public Health England	M	Cole
12.	Public Health England	J	Conneely
13.	Public Health England	S	D'Arcangelo
14.	Public Health England	J	Ellis
15.	Public Health England	S	Evans
16.	Public Health England	S	Foulkes
17.	Public Health England	N	Gillson
18.	Public Health England	R	Gopal
19.	Public Health England	L	Hall
20.	Public Health England	VJ	Hall
21.	Public Health England	P	Harrington
22.	Public Health England	S	Hopkins
23.	Public Health England	J	Hewson
24.	Public Health England	K	Hoschler
25.	Public Health England	D	Ironmonger
26.	Public Health England	J	Islam
27.	Public Health England	M	Kall
28.	Public Health England	I	Karagiannis
29.	Public Health England	O	Kay
30.	Public Health England	J	Khawam
31.	Public Health England	E	King
32.	Public Health England	P	Kirwan
33.	Public Health England	R	Kyffin
34.	Public Health England	A	Lackenby
35.	Public Health England	M	Lattimore
36.	Public Health England	E	Linley
37.	Public Health England	J	Lopez-Bernal
38.	Public Health England	L	Mabey
39.	Public Health England	R	McGregor
40.	Public Health England	S	Miah
41.	Public Health England	EMJ	Monk
42.	Public Health England	K	Munro
43.	Public Health England	Z	Naheed
44.	Public Health England	A	Nissr
45.	Public Health England	AM	O'Connell
46.	Public Health England	B	Oguti

47.	Public Health England	H	Okafor
48.	Public Health England	S	Organ
49.	Public Health England	J	Osbourne
50.	Public Health England	A	Otter
51.	Public Health England	M	Patel
52.	Public Health England	S	Platt
53.	Public Health England	D	Pople
54.	Public Health England	K	Potts
55.	Public Health England	M	Ramsay
56.	Public Health England	J	Robotham
57.	Public Health England	S	Rokadiya
58.	Public Health England	C	Rowe
59.	Public Health England	A	Saei
60.	Public Health England	G	Sebbage
61.	Public Health England	A	Semper
62.	Public Health England	M	Shrotri
63.	Public Health England	R	Simmons
64.	Public Health England	A	Soriano
65.	Public Health England	P	Staves
66.	Public Health England	S	Taylor
67.	Public Health England	A	Taylor
68.	Public Health England	A	Tengbe
69.	Public Health England	S	Tonge
70.	Public Health England	A	Vusirikala
71.	Public Health England	S	Wallace
72.	Public Health England	E	Wellington
73.	Public Health England	M	Zambon
<b>Northern Ireland</b>			
74.	Health and Social Care Agency Northern Ireland	D	Corrigan
75.	Health and Social Care Agency Northern Ireland	M	Sartaj
76.	Health and Social Care Agency Northern Ireland	L	Cromey
77.	Health and Social Care Agency Northern Ireland	S	Campbell
78.	Health and Social Care Agency Northern Ireland	K	Braithwaite
<b>Scotland</b>			
79.	Glasgow Caledonian University	L	Price
80.	Public Health Scotland	L	Haahr
81.	Public Health Scotland	S	Stewart
<b>Wales</b>			
82.	Public Health Wales	ED	Lacey
83.	Public Health Wales	L	Partridge
84.	Public Health Wales	G	Stevens
85.	Research Wales	Y	Ellis
86.	Research Wales	H	Hodgson
87.	Research Wales	C	Norman
<b>Participating SIREN sites</b>			
88.	Alder Hey Children's NHS Foundation Trust	B	Larru
89.	Alder Hey Children's NHS Foundation Trust	S	Mcwilliam
90.	Ashford and St Peter's Hospitals NHS Foundation Trust	S	Winchester
91.	Basildon and Thurrock University Hospitals NHS Foundation Trust	P	Cieciwa

92.	Basildon and Thurrock University Hospitals NHS Foundation Trust	A	Pai
93.	Belfast Health & Social Care Trust	C	Loughrey
94.	Belfast Health & Social Care Trust	A	Watt
95.	Birmingham Community Healthcare NHS Foundation Trust	F	Adair
96.	Birmingham Community Healthcare NHS Foundation Trust	A	Hawkins
97.	Black Country Healthcare NHS Foundation Trust	A	Grant
98.	Black Country Healthcare NHS Foundation Trust	R	Temple-Purcell
99.	Blackpool Teaching Hospitals NHS Foundation Trust	J	Howard
100.	Blackpool Teaching Hospitals NHS Foundation Trust	N	Slawson
101.	Bolton NHS Foundation Trust	C	Subudhi
102.	Brighton and Sussex University Hospitals NHS Trust	S	Davies
103.	Brighton and Sussex University Hospitals NHS Trust	A	Bexley
104.	Buckinghamshire Healthcare NHS Trust	R	Penn
105.	Buckinghamshire Healthcare NHS Trust	N	Wong
106.	Calderdale and Huddersfield NHS Foundation Trust	G	Boyd
107.	Calderdale and Huddersfield NHS Foundation Trust	A	Rajgopal
108.	Central and North West London NHS Foundation Trust	A	Arenas-Pinto
109.	Central and North West London NHS Foundation Trust	R	Matthews
110.	Chesterfield Royal Hospital NHS Foundation Trust	A	Whileman
111.	Cornwall Partnership NHS Foundation Trust	R	Laugharne
112.	Cornwall Partnership NHS Foundation Trust	J	Ledger
113.	Countess of Chester Hospital NHS Foundation Trust	T	Barnes,
114.	Countess of Chester Hospital NHS Foundation Trust	C	Jones

115.	Dartford and Gravesham NHS Trust	D	Botes
116.	Dartford and Gravesham NHS Trust	N	Chitalia
117.	Derbyshire Healthcare NHS Foundation Trust	S	Akhtar
118.	Derbyshire Healthcare NHS Foundation Trust	G	Harrison
119.	Devon Partnership NHS Trust	S	Horne
120.	Devon Partnership NHS Trust	N	Walker
121.	Doncaster and Bassetlaw Teaching Hospitals NHS Foundation Trust	K	Agwuh
122.	Doncaster and Bassetlaw Teaching Hospitals NHS Foundation Trust	V	Maxwell
123.	Dorset County Hospital NHS Foundation Trust	J	Graves
124.	Dorset County Hospital NHS Foundation Trust	S	Williams
125.	Dorset Healthcare University NHS Foundation Trust		Research and Development and Occupational Health Departments
126.	East Suffolk and North Essex NHS Foundation Trust	A	O'Kelly
127.	East Suffolk and North Essex NHS Foundation Trust	P	Ridley
128.	East Sussex Healthcare NHS Trust	A	Cowley
129.	Epsom and St Helier University Hospitals NHS Trust	H	Johnstone
130.	Epsom and St Helier University Hospitals NHS Trust	P	Swift
131.	Frimley Health NHS Foundation Trust	J	Democratis
132.	Frimley Health NHS Foundation Trust	M	Meda

133.	George Eliot Hospital NHS Trust	C	Callens
134.	Gloucestershire Hospitals NHS Foundation Trust	S	Beazer
135.	Gloucestershire Hospitals NHS Foundation Trust	S	Hams
136.	Golden Jubilee National Hospital	V	Irvine
137.	Great Western Hospitals NHS Foundation Trust	B	Chandrasekaran
138.	Great Western Hospitals NHS Foundation Trust	C	Forsyth
139.	Hampshire Hospitals NHS Foundation Trust	J	Radmore
140.	Hampshire Hospitals NHS Foundation Trust	C	Thomas
141.	Hounslow and Richmond Community Healthcare NHS Trust	K	Brown
142.	Hounslow and Richmond Community Healthcare NHS Trust	S	Roberts
143.	Hull University Teaching Hospitals NHS Trust	P	Burns
144.	Hull University Teaching Hospitals NHS Trust	K	Gajee
145.	Imperial College Healthcare NHS Trust	TM	Byrne
146.	Imperial College Healthcare NHS Trust	F	Sanderson
147.	Isle of Wight NHS Trust	S	Knight
148.	Isle of Wight NHS Trust	E	Macnaughton
149.	James Paget University Hospitals NHS Foundation Trust	BJL	Burton
150.	James Paget University Hospitals NHS Foundation Trust	H	Smith
151.	King's College Hospital NHS Foundation Trust	R	Chaudhuri
152.	Lancashire & South Cumbria NHS Foundation Trust	K	Hollinshead

153.	Lancashire & South Cumbria NHS Foundation Trust	RJ	Shorten
154.	Lancashire Teaching Hospitals NHS Foundation Trust	A	Swan
155.	Lancashire Teaching Hospitals NHS Foundation Trust	RJ	Shorten
156.	Leeds Teaching Hospitals NHS Trust	C	Favager
157.	Leeds Teaching Hospitals NHS Trust	J	Murira
158.	Leicestershire Partnership NHS Trust	S	Baillon
159.	Leicestershire Partnership NHS Trust	S	Hamer
160.	Lewisham and Greenwich NHS Trust	K	Gantert
161.	Lewisham and Greenwich NHS Trust	J	Russell
162.	Lincolnshire Partnership NHS Foundation Trust	D	Brennan
163.	Lincolnshire Partnership NHS Foundation Trust	A	Dave
164.	Liverpool University Hospitals NHS Foundation Trust	A	Chawla
165.	Liverpool University Hospitals NHS Foundation Trust	F	Westell
166.	London North West University Healthcare NHS Trust	D	Adeboyeku
167.	London North West University Healthcare NHS Trust	P	Papineni
168.	Maidstone and Tunbridge Wells NHS Trust	C	Pegg
169.	Maidstone and Tunbridge Wells NHS Trust	M	Williams
170.	Manchester University NHS Foundation Trust	S	Ahmad
171.	Manchester University NHS Foundation Trust	S	Ingram
172.	Mid Cheshire Hospitals NHS Foundation Trust	C	Gabriel
173.	Mid Cheshire Hospitals NHS Foundation Trust	K	Pagget
174.	Mid Essex Hospital Services NHS Trust	P	Cieciwa
175.	Mid Essex Hospital Services NHS Trust	G	Maloney



176.	Mid Yorkshire Hospitals NHS Trust	J	Ashcroft
177.	Mid Yorkshire Hospitals NHS Trust	I	Del Rosario
178.	Moorfields Eye Hospital NHS Foundation Trust	R	Crosby-Nwaobi
179.	Moorfields Eye Hospital NHS Foundation Trust	C	Reeks
180.	NHS Fife	S	Fowler
181.	NHS Forth Valley	L	Prentice
182.	NHS Forth Valley	M	Spears
183.	NHS Grampian	G	McKerron
184.	NHS Grampian	K	McLelland-Brooks
185.	NHS Greater Glasgow and Clyde	J	Anderson
186.	NHS Lothian	S	Donaldson
187.	NHS Lothian	K	Templeton
188.	Norfolk and Norwich University Hospitals NHS Foundation Trust	L	Coke
189.	Norfolk and Norwich University Hospitals NHS Foundation Trust	N	Elumogo
190.	North Cumbria Integrated Care NHS Foundation Trust	J	Elliott
191.	North Cumbria Integrated Care NHS Foundation Trust	D	Padgett
192.	North Middlesex University Hospital NHS Trust	A	Cross
193.	North Middlesex University Hospital NHS Trust	J	Price
194.	North West Anglia NHS Foundation Trust	S	Joyce
195.	North West Anglia NHS Foundation Trust	I	Sinanovic

196.	Northern Devon Healthcare NHS Trust	M	Howard
197.	Northern Devon Healthcare NHS Trust	T	Lewis
198.	Northern Lincolnshire and Goole NHS Foundation Trust	P	Cowling
199.	Northern Lincolnshire and Goole NHS Foundation Trust	D	Potoczna
200.	Nottingham University Hospitals NHS Trust	S	Brand
201.	Poole Hospital NHS Foundation Trust	L	Sheridan
202.	Poole Hospital NHS Foundation Trust	B	Wadams
203.	Portsmouth Hospitals NHS Trust	A	Lloyd
204.	Portsmouth Hospitals NHS Trust	J	Mouland
205.	Queen Victoria Hospital NHS Foundation Trust	J	Giles
206.	Queen Victoria Hospital NHS Foundation Trust	G	Pottinger
207.	Royal Berkshire NHS Foundation Trust	H	Coles
208.	Royal Berkshire NHS Foundation Trust	M	Joseph
209.	Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust	M	Lee
210.	Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust	S	Orr
211.	Royal Cornwall Hospitals NHS Trust	H	Chenoweth
212.	Royal Devon and Exeter NHS Foundation Trust	C	Auckland
213.	Royal Devon and Exeter NHS Foundation Trust	R	Lear
214.	Royal Free London NHS Foundation Trust	T	Mahungu

215.	Royal Free London NHS Foundation Trust	A	Rodger
216.	Royal National Orthopaedic Hospital NHS Trust	K	Penny-Thomas
217.	Royal Papworth Hospital NHS Foundation Trust	S	Pai
218.	Royal Papworth Hospital NHS Foundation Trust	J	Zamikula
219.	Royal Surrey County Hospital NHS Foundation Trust	E	Smith
220.	Royal Surrey County Hospital NHS Foundation Trust	S	Stone
221.	Royal United Hospitals Bath NHS Foundation Trust	E	Boldock
222.	Royal United Hospitals Bath NHS Foundation Trust	D	Howcroft
223.	Salisbury NHS Foundation Trust	C	Thompson
224.	Sandwell and West Birmingham Hospitals NHS Trust	M	Aga
225.	Sandwell and West Birmingham Hospitals NHS Trust	P	Domingos
226.	Sheffield Children's NHS Foundation Trust	S	Gormley
227.	Sheffield Children's NHS Foundation Trust	C	Kerrison
228.	Sheffield Teaching Hospitals NHS Foundation Trust	L	Marsh
229.	Sheffield Teaching Hospitals NHS Foundation Trust	S	Tazzyman
230.	Sherwood Forest Hospitals NHS Foundation Trust	L	Allsop
231.	Sherwood Forest Hospitals NHS Foundation Trust	S	Ambalkar
232.	Shrewsbury and Telford Hospital NHS Trust	M	Beekes
233.	Shrewsbury and Telford Hospital NHS Trust	S	Jose

234.	Shropshire Community Health NHS Trust	J	Tomlinson
235.	Solent NHS Trust	A	Jones
236.	Solent NHS Trust	C	Price
237.	Somerset NHS Foundation Trust	J	Pepperell
238.	Somerset NHS Foundation Trust	M	Schultz
239.	Southend University Hospital NHS Foundation Trust	J	Day
240.	Southern Health & Social Care Trust	A	Boulos
241.	Southern Health NHS Foundation Trust	E	Defever
242.	Southern Health NHS Foundation Trust	D	McCracken
243.	Southport and Ormskirk Hospital NHS Trust	K	Brown
244.	Southport and Ormskirk Hospital NHS Trust	K	Gray
245.	St George's University Hospitals NHS Foundation Trust	A	Houston
246.	St George's University Hospitals NHS Foundation Trust	T	Planche
247.	St Helens and Knowsley Teaching Hospitals NHS Trust	R	Pritchard Jones
248.	St Helens and Knowsley Teaching Hospitals NHS Trust	Diane	Wycherley
249.	Stockport NHS Foundation Trust	S	Bennett
250.	Stockport NHS Foundation Trust	J	Marrs
251.	Surrey and Sussex Healthcare NHS Trust	K	Nimako
252.	Surrey and Sussex Healthcare NHS Trust	B	Stewart
253.	The Clatterbridge Cancer Centre NHS Foundation Trust		
	The Clatterbridge Cancer Centre NHS Foundation Trust	N	Kalakonda

254.			
255.	The Clatterbridge Cancer Centre NHS Foundation Trust	S	Khanduri
256.	The Dudley Group NHS Foundation Trust	A	Ashby
257.	The Hillingdon Hospitals NHS Foundation Trust	M	Holden
258.	The Hillingdon Hospitals NHS Foundation Trust	N	Mahabir
259.	The Newcastle Upon Tyne Hospitals NHS Foundation Trust	J	Harwood
260.	The Newcastle Upon Tyne Hospitals NHS Foundation Trust	B	Payne
261.	The Princess Alexandra Hospital NHS Trust	K	Court
262.	The Princess Alexandra Hospital NHS Trust	N	Staines
263.	The Robert Jones and Agnes Hunt Orthopaedic Hospital NHS Foundation Trust	R	Longfellow
264.	The Royal Wolverhampton NHS Trust	ME	Green
265.	The Royal Wolverhampton NHS Trust	LE	Hughes
266.	Torbay and South Devon NHS Foundation Trust	M	Halkes
267.	Torbay and South Devon NHS Foundation Trust	P	Mercer
268.	United Lincolnshire Hospitals NHS Trust	A	Roebuck
269.	United Lincolnshire Hospitals NHS Trust		Research Team LCRF
270.	University Hospital Southampton NHS Foundation Trust	E	Wilson-Davies
271.	University Hospitals Bristol and Weston NHS Foundation Trust	L	Gallego
272.	University Hospitals Bristol and Weston NHS Foundation Trust	R	Lazarus

273.	University Hospitals Coventry and Warwickshire NHS Trust	N	Aldridge
274.	University Hospitals Coventry and Warwickshire NHS Trust	L	Berry
275.	University Hospitals of Derby and Burton NHS Foundation Trust:	F	Game
276.	University Hospitals of Derby and Burton NHS Foundation Trust:	T	Reynolds
277.	University Hospitals of Leicester NHS Trust	C	Holmes
278.	University Hospitals of Leicester NHS Trust	M	Wiselka
279.	University Hospitals of Morecambe Bay NHS Foundation Trust	A	Higham
280.	University Hospitals of North Midlands NHS Trust	M	Booth
281.	University Hospitals of North Midlands NHS Trust	C	Duff
282.	University Hospitals Plymouth NHS Trust	J	Alderton
283.	University Hospitals Plymouth NHS Trust	H	Jory
284.	Walsall Healthcare NHS Trust	E	Virgilio
285.	Warrington and Halton Teaching Hospitals NHS Foundation Trust	T	Chin
286.	Warrington and Halton Teaching Hospitals NHS Foundation Trust	MZ	Qazzafi
287.	West Suffolk NHS Foundation Trust	AM	Moody
288.	West Suffolk NHS Foundation Trust	R	Tilley
289.	Western Health & Social Care Trust	T	Donaghy
290.	Western Sussex Hospitals NHS Foundation Trust	K	Shipman
291.	Western Sussex Hospitals NHS Foundation Trust	R	Sierra

292.	Whittington Health NHS Trust	N	Jones
293.	Whittington Health NHS Trust	G	Mills
294.	Wirral University Teaching Hospital NHS Foundation Trust	D	Harvey
295.	Wirral University Teaching Hospital NHS Foundation Trust	YWJ	Huang
296.	Wye Valley NHS Trust	J	Birch
297.	Wye Valley NHS Trust	L	Robinson
298.	Yeovil District Hospital NHS Foundation Trust	S	Board
299.	Yeovil District Hospital NHS Foundation Trust	A	Broadley
300.	York Teaching Hospital NHS Foundation Trust	C	Laven
301.	York Teaching Hospital NHS Foundation Trust	N	Todd
<b>SIREN Associated Studies</b>			
302.	Oxford University Hospital Study, University of Oxford	DW	Eyre
303.	Oxford University Hospital Study, Oxford University Hospitals NHS Foundation Trust	K	Jeffery
304.	Protective Immunity from T cells to Covid-19 in Health workers (PITCH)	S	Dunachie
305.	Protective Immunity from T cells to Covid-19 in Health workers (PITCH)	C	Duncan
306.	Protective Immunity from T cells to Covid-19 in Health workers (PITCH)	P	Klenerman
307.	Protective Immunity from T cells to Covid-19 in Health workers (PITCH)	L	Turtle
308.	The Humoral Immune Correlates for COVID-19 (HICC) consortium	H	Baxendale
309.	The Humoral Immune Correlates for COVID-19 (HICC) consortium	JL	Heeney